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Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

1785
The University of Georgia
Savannah River Ecology Laboratory

Thresholds of Disturbance:

Land Management Effects on Vegetation and Nitrogen Dynamics

CS-1114E-00

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BRIEF TO THE SCIENTIFIC ADVISORY BOARD

13 JUNE, 2001

PERFORMERS

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Disturbance Ecology

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PROBLEM STATEMENT

DoD (Fort Benning) land must sustain the military training mission. A second land management goal at Fort Benning is sustainable upland forests, including longleaf pine forest, which provides economic benefits and suppor red red-cockaded wood

Fort Benning managers need information to determine what combinations of land management practices - due to military training and longleaf pine forestry - exceed thresholds beyond which upland ecosystems are not sustainable (will not

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TECHNICAL OBJECTIVE

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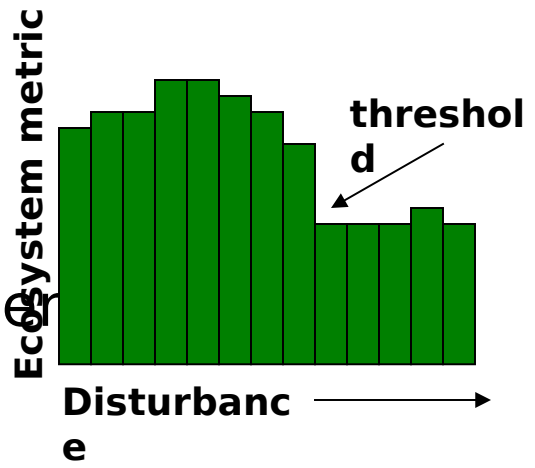
To evaluate the ecological effects of military training and forest management for longleaf pine at Ft. Benning, to determine if there are thresholds beyond which upland ecosystems cannot sustain the combined effects of these land use disturbances.

TECHNICAL BACKGROUND



- Disturbances

  - can be key to ecosystem management

- Intensity and frequency of land management-derived disturbances

  - can influence ecosystem composition, structure, trajectory

- Combinations of disturbances greater than some intensity/frequency

  - cause ecosystems to not recover, lose species, or change trajectory

  - systems are not sustainable

TECHNICAL BACKGROUND

At Fort Benning.....

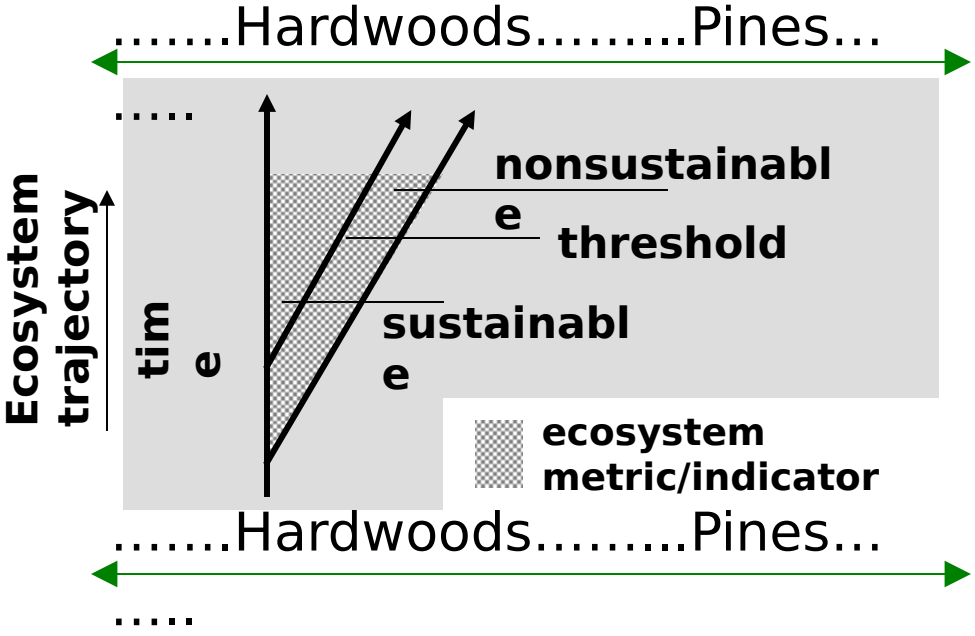
Time / space

Soil type, topography

Canopy opening and soil disturbance due to:

military training; forest thinning, burning

TECHNICAL BACKGROUND



Disturbances due to land use practices (military training, forest management)

- can modify natural or management-defined ecosystem trajectory beyond sustainability threshold

TECHNICAL APPROACH

Hypothesis: underlying soil type partly determines forest composition and dynamics; influences the disturbance threshold for sustainability

- Experimental approach
  - metrics: biogeochemical (nitrogen, carbon) cycling, plant species diversity, vegetation dynamics and structure
- Sites with sandy vs. clayey soil, combinations of
  - forest management for longleaf pine: (2 yr vs. 4 yr burn cycle; thinned vs. unthinned)
  - lighter vs. heavier military training

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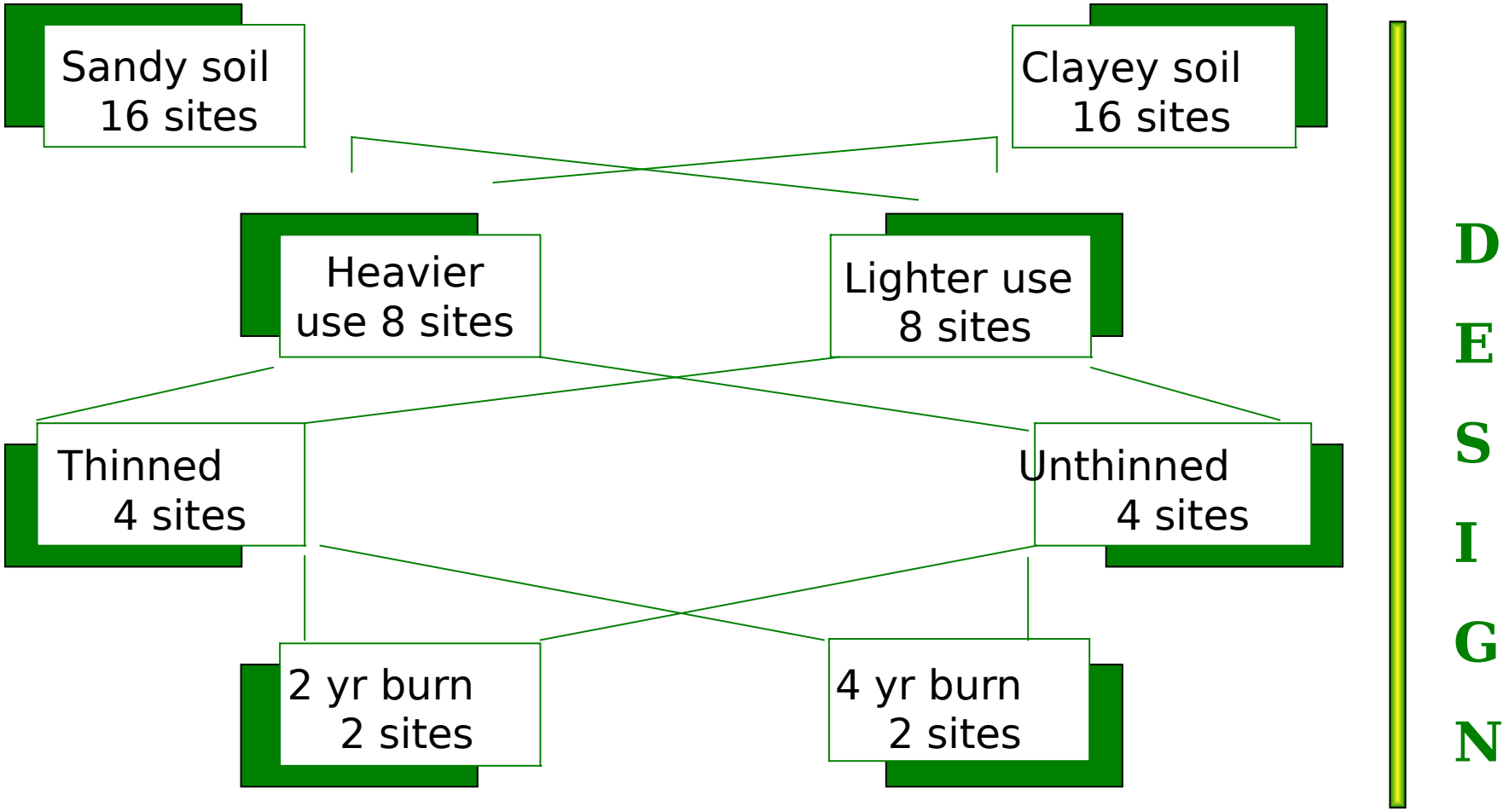
TECHNICAL APPROACH



ACCOMPLISHMENTS

STATUS

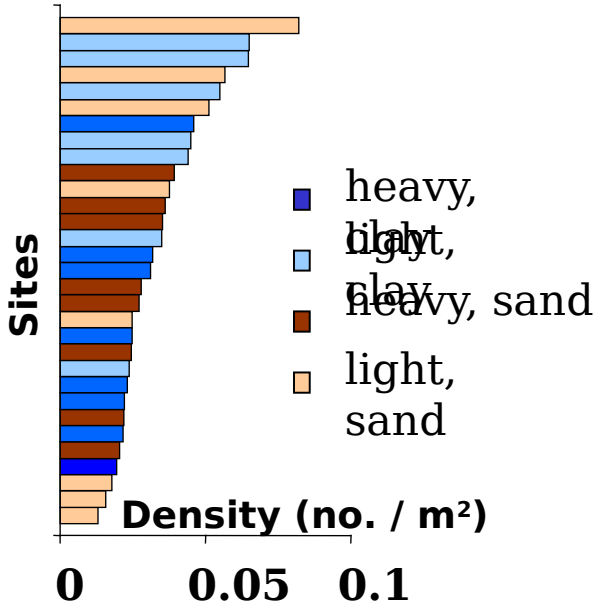
- Sites selected (3-5/00)
- Baseline vegetation survey (6-8/00)
- Disturbance features survey (9-10/00)
- Baseline soil texture analyses (9/00 - 2/01)
- Oak/pine seedlings introduced (1-3/01)
- Monitoring equipment/sensors deployed (1-4/01)
- Stable isotope (^{15}N) litter deployed (pilot project) (3-4/01)

ACCOMPLISHMENTS

UNDERSTANDING - vegetation

- 29/32 selected sites dominated by pines
- initial analyses suggest canopy and ground layer composition reflect site differences and intensity of land use

- tree species richness does not differ between soil types, but is reduced ca. 50% with heavy land use on clayey sites

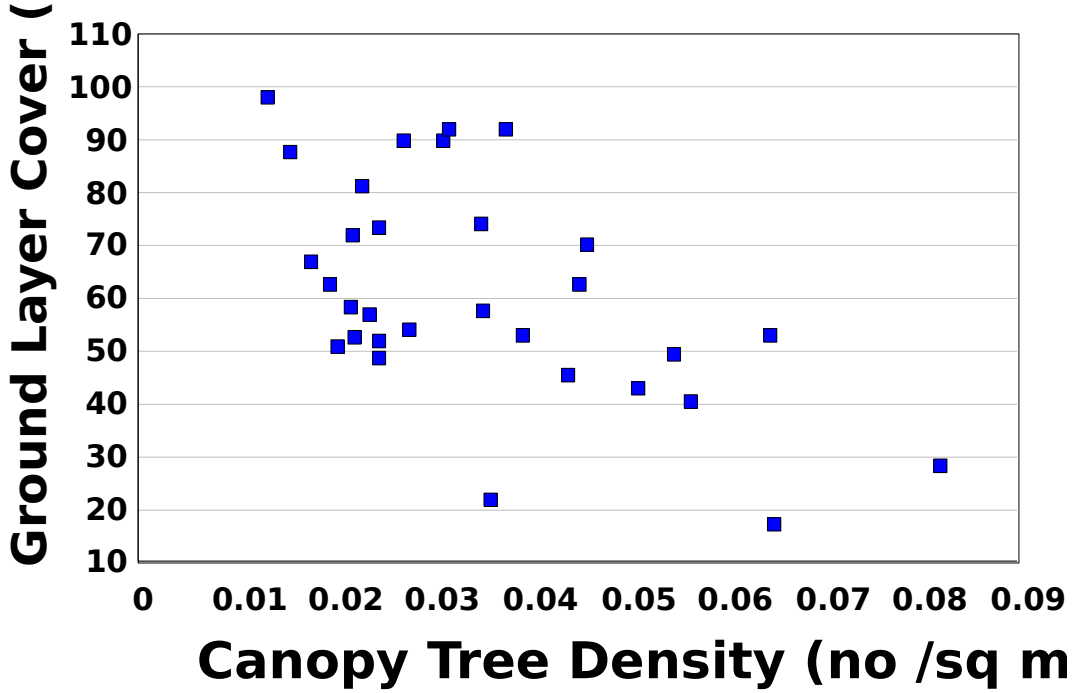


- tree density is greater on sites with lighter vs. heavier military training

ACCOMPLISHMENTS

UNDERSTANDING - vegetation

- initial analyses suggest canopy and ground layer composition reflect site differences and intensity of land use



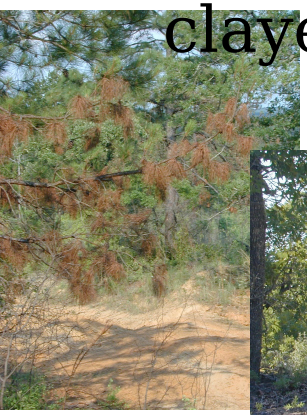
- in clayey sites, ground layer cover is negatively related to tree density (more cover in more open sites), which potentially reflects forest management history

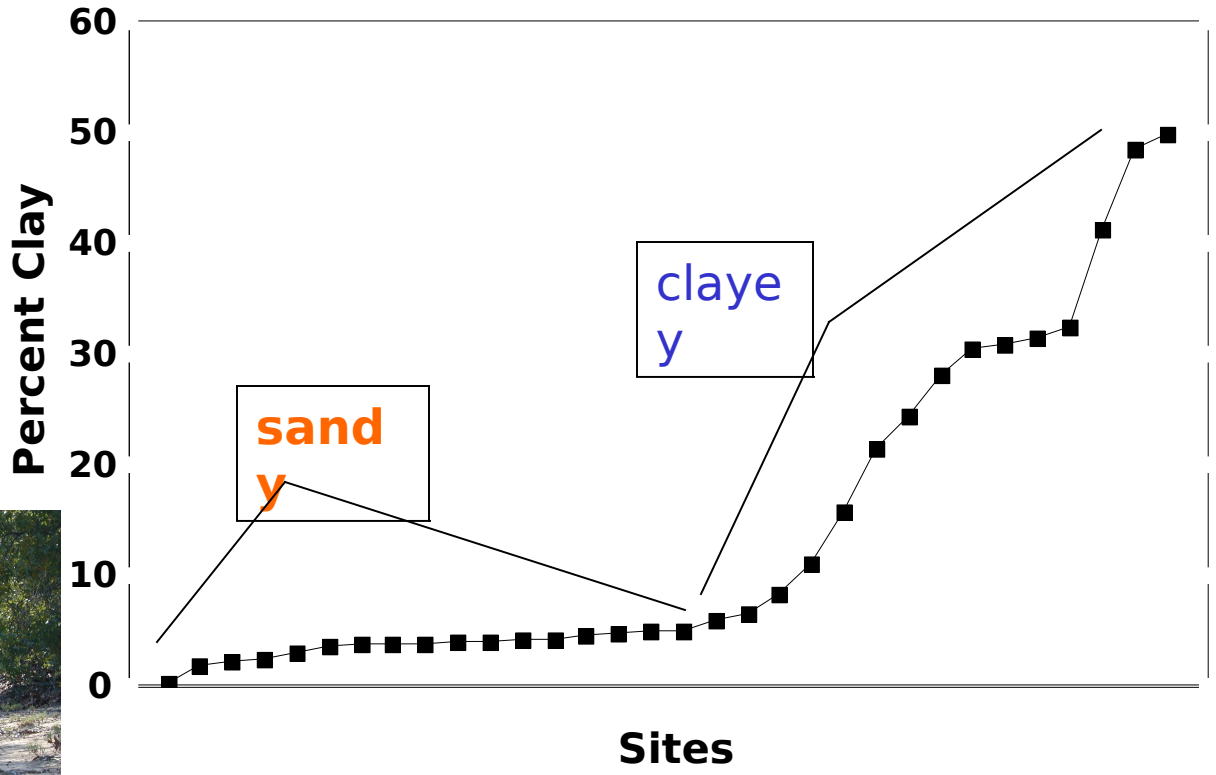
ACCOMPLISHMENTS

UNDERSTANDING - soil texture

- soil texture (% clay) is more uniform in sandy sites (3 % - 5 % clay) than in clayey sites (6 % to 50 % clay)

- ecosystem responses to soil texture might vary more among clayey sites





ACCOMPLISHMENTS

UNDERSTANDING - disturbance features

- surveyed natural, military use, and forestry disturbances in each site
- at least 4 different types of disturbance features are found in each site; 7 % to 50 % of sampled area was disturbed
- disturbance features range from small (treefalls, depressions) through large (canopy gaps, bare areas, clearcuts)
- remnant roads are the most common disturbance feature; they occupied 14 % of the total disturbed area

ACCOMPLISHMENTS

UNDERSTANDING - disturbance features

- surveyed *all* natural, military use, and forestry disturbances in each site

•depressio n

•ditch

•gully

•erosion

•firebreak

•mou

•berm

•treefall

•gap

•clearcut

•skidder trail

•unimprov ed road

•road

•tank trail

•tank area

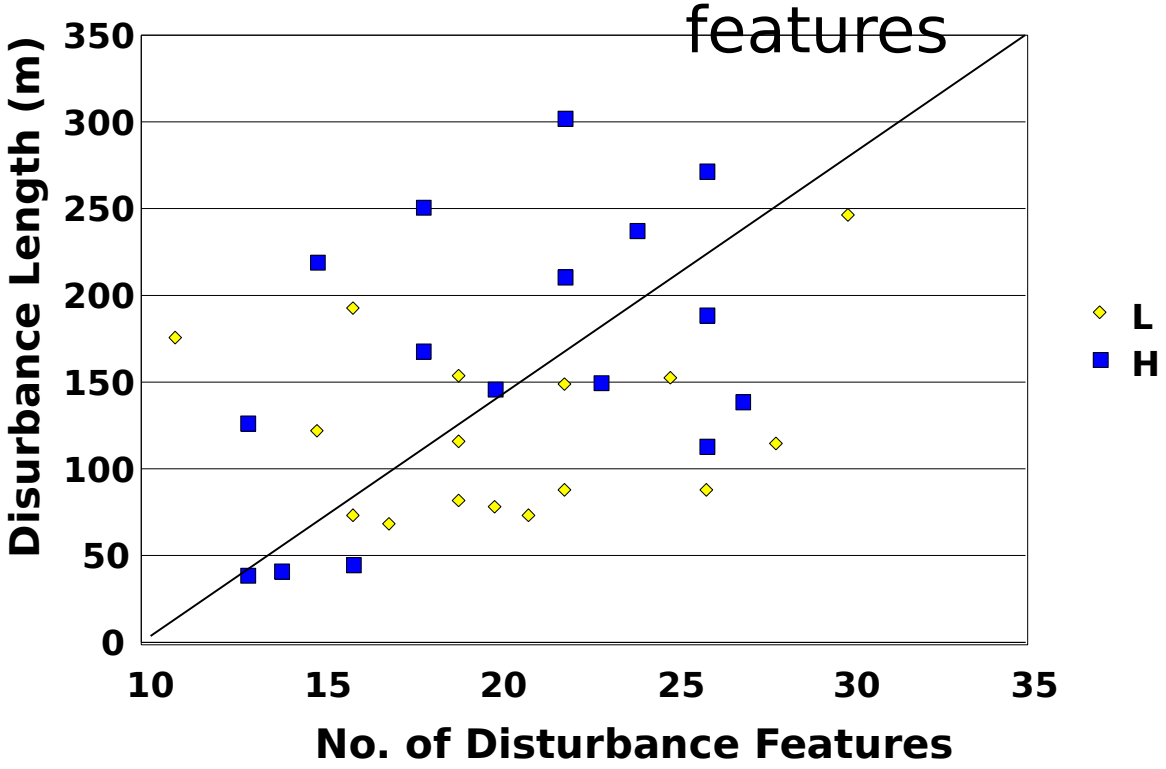
•bare area

•remnant trail

•remnant

ACCOMPLISHMENTS

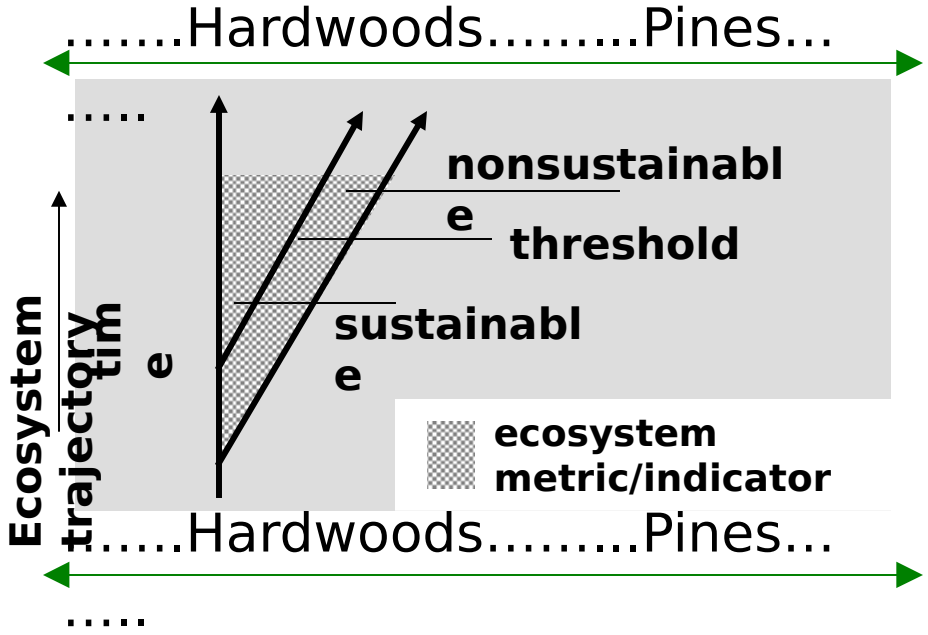
UNDERSTANDING - disturbance features



- sites with heavier military use do not necessarily have more disturbance features than lighter use sites (H sites are not grouped to the right on the x-axis), but tend to have a greater amount of disturbance (H sites tend to fall above the diagonal line)

ACCOMPLISHMENTS

INTEGRATION



- Canopy and ground layer vegetation composition, richness, and density (cover) indicate intensity of past, longer-term land use disturbances.

- Baseline data suggest response to disturbance may be greater on clayey soils as hypothesized
  - lower threshold for sustainability on clayey soils?

PROGRAM PLAN

NEXT STEPS

2001 tasks (year preceding YR2 burn)

- Monitor field environment
  - soil, air temperature; canopy; rainfall; soil moisture
- Monitor vegetation
  - ground layer composition, seed influx, potential indicator species (e.g., legumes), phytometer (oak, pine) seedlings
- N transformation studies
  - litter decomposition, net NH_4/NO_3 availability

Analyses of metrics of ecosystem response to military training and forest management treatment combinations that are not sustainable

PRODUCTS

- **Collins, B. Land use and disturbance on DOE and DoD sites. Westinghouse Environmental Advisory Committee Meeting. SRS, 8 November, 2000.**
- **Collins, B., J. Dilustro, L. Duncan, R. Sharitz, J V. McArthur, C. Romanek, J. Seaman, D. Imm, M. Cadenasso, and P. White. Thresholds of disturbance: land management effects on vegetation and nitrogen dynamics. SERDP Annual Technical Symposium, Arlington, VA. 28-30 November, 2000.**
- **Dilustro, J. , B. Collins, L. Duncan, R. Sharitz, J V. McArthur, C. Romanek, and J. Seaman. 2001. Thresholds of disturbance: land management effects on vegetation and nitrogen dynamics. Southeastern Biology 48(2):80.**
- **Partners Along the Fall-Line: Sandhills Ecology and Ecosystem Management Workshop. SREL Conference Center, March, 2001.**
- **Dilustro, J. , B. Collins, L. Duncan, R. Sharitz, J V. McArthur, C. Romanek, and J. Seaman. Thresholds of disturbance: land management effects on vegetation and nitrogen dynamics. Ecological Society of America, August, 2001.**
- **Collins, B., J. Dilustro, L. Duncan, and R. Sharitz. Soil type and disturbance intensity effects on vegetation: an example from**